Renewables Are Ready: A Guide to Teaching Renewable Energy in Jr and Sr High School Classrooms

Union of Concerned Scientists
Publications Unit
Two Brattle Square
P.O. Box 9105
Cambridge, MA 02238-9105
617-547-5552
617-864-9405 (fax)
http://www.ucsusa.org

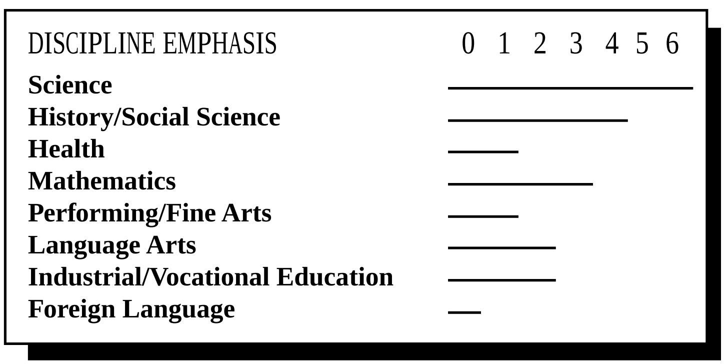
$5 for single copies, $3 each for orders of 10 or more. Add 20% for shipping and handling. 101 pages, 1994.

Grades 7-12. Evaluation based on review of materials for grades 7-9

This guide is intended to introduce students to renewable energy technologies and to the political and economic conditions necessary for their implementation.

REPORT CARD

Overall Grade	**A**
General Content	**A**
Presentation	**A-**
Pedagogy	**A**
Teacher Usability	**A**
Energy Content	**A**



COMMENTS

General Content
Action projects personalize the issue and solutions. Balances science and social studies; even addresses economics. Very thorough.

Presentation
Activities are well thought out to teach a single concept, and are grouped to explore renewable/nonrenewable energy in a short, comprehensive way.

Pedagogy
Good balance of hands-on, concrete activities including role playing public discourse. Good, embedded, authentic assessment.

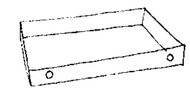
Teacher Usability
Comprehensive teacher resource section is short, sweet, high powered and not easy to read and use.

Energy Content
Addresses renewable energy.

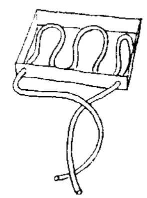
How to Build a Solar Water Heater

STUDENT HANDOUT

1. Poke two holes in the box at opposite ends of one side. Make them the size of the tubing you will use. Glue aluminum foil on the inside of the box and paint the box black inside.



2. Insert tubing through one hole and curl it around the bottom of the box. Poke the tubing out the hole at the other end. Leave roughly equal amounts of tubing sticking out of both ends of the box.



3. Paint the tubing inside the box completely black.

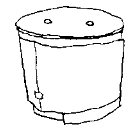
4. If the tubing does not stay at the bottom of the box, pin it down. Do this by bending a paper clip. Stick it around the tubing through the bottom of the box. Bend the clip ends on the other side, clamping the tubing down. Tape a thermometer to the bottom of the box.

5. Cover the box with plastic wrap, glass, or Plexiglas. Tape it on so that it is airtight. If you use plastic wrap, stretch it so that there are no wrinkles.

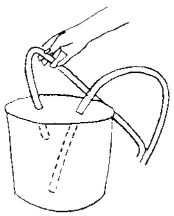
How to Build a Solar Water Heater

STUDENT HANDOUT

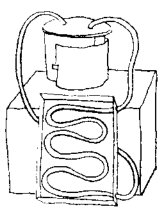
6. If the buckets you use do not have tops, make tops out of cardboard. Insulate the buckets by taping sheets of newspaper around them. Poke two holes in the top of one of the buckets for the tubing. This is your experiment bucket. The other bucket will be your control.



7. Fill both buckets with water. Insert tubing in your experiment bucket. Make sure that one end of the tubing is near the top, the other at the bottom. You may need to cut off some excess tubing to do this.



8. Prop up the box at a slant so that it is facing the sunlight (its shadow should be directly behind it). Place the experiment bucket on some support (books or another box will work), so that it is *completely* above the level of the collector. Arrange the control bucket at the same level.



9. Suck on one end of the tubing in the control bucket to fill the water pipe with water. Make sure there is no air in the pipe when you insert it back in the water.

10. Leave the solar heater and control bucket out in the sun for 1 or 2 hours and measure the temperature of the water periodically, as well as the temperature inside the heater.

Environmental Science Activities Kit

Prentice Hall
Order Processing Department
P.O. Box 11071
Des Moines, Iowa 50336
515-284-6751
515-284-2607 (fax)
http://www.phdirect.com/phdirect

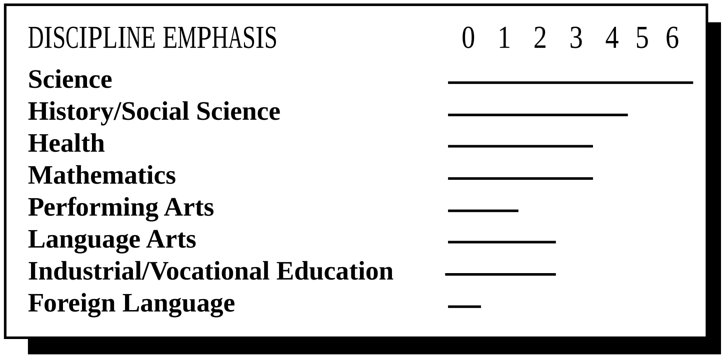
$29.95; 332 pages, 1993.

Grades 7-12. Evaluation based on review of materials for grades 7-9

Thirty-two interdisciplinary science lessons organized into six topical units focusing on major environmental issues.

REPORT CARD

Overall Grade	**A**
General Content	**A**
Presentation	**A-**
Pedagogy	**A**
Teacher Usability	**A**
Energy Content	**A**



COMMENTS

General Content
Gives a comprehensive view of the topic with a variety of lessons to choose from. Thorough coverage of each topic.

Presentation
Layout is clear and easy to follow. Pictures and graphics are needed.

Pedagogy
Paper and pencil intensive. Assessment imbedded but dependent on a worksheet. Lesson styles provide limited diversity to accommodate different learning styles. Extends critical thinking.

Teacher Usability
Teacher background information and preparation instructions are extremely helpful. Good for new teachers. Easy to obtain materials.

Energy Content
Practical development of several concepts related to energy applications.

Additional Evaluator Thoughts
Kids would love doing these activities. Fun and educational.

21.1 Catch the Sun!: Background Information

People have always used the sun as a heating source. When we open our window curtains to let the sun in, we are using **solar** energy. When we burn wood in our fireplaces, we are using solar energy that has been stored by trees. Even when we use oil, coal, or natural gas to heat our homes, we are using solar energy that has been stored in these **"fossil fuels"** for millions of years. Since most of our electricity is generated by burning fossil fuels, even most of our electricity is generated by stored solar energy!

As the price of **nonrenewable** fossil fuels increases, and as people become more aware of and concerned about the environmental problems caused by fossil fuels and nuclear power, people are looking more closely at using solar energy for heating their homes. Solar energy can be used to produce electricity, heat water, cook, or even to cool homes!

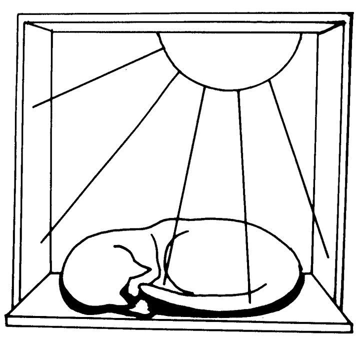
When we use solar energy without electrical devices to increase circulation, it is called **"passive"** solar technology. A simple window is an example of a passive solar energy collector.

When we use fans or pumps to circulate the heated air or water, that is called **"active"** solar technology. Many rooftop solar water heaters use pumps and so are referred to as active systems.

There are about 500,000 homes in the United States that have passive solar designs. Many of these homes are not in the southern states where one might expect them to be more common. In fact, effective, affordable, and comfortable solar-heated homes can and have been built in most areas of the United States. As energy costs increase and new designs and technology become available, more solar homes will be built.

Solar energy can be focused on materials to be burned or melted in a furnace. It can also be focused on boilers to produce steam to generate electricity. There are several places in the world, including some in the United States, where solar energy is currently being used to generate electricity commercially. A 200-megawatt plant near Los Angeles produces enough electricity for 270,000 people. Such plants cost no more than nuclear power plants, take much less time to build, use a renewable energy source, and do not produce dangerous nuclear by-products.

Solar energy can be converted directly to electricity by solar cells (photovoltaic cells). You have probably seen or used a calculator that is powered by a solar cell. Groups of cells can be coupled together to form panels that can be mounted on houses, cars, and even airplanes! They provide electricity that can be used immediately or stored in batteries. Photovoltaic technology is advancing rapidly, and electricity produced by solar cells may soon be competitive with other sources of electricity. It already is competitive in out-of-the-way places where it is not economical to run electrical lines.



Name ______________________ Class __________ Date __________

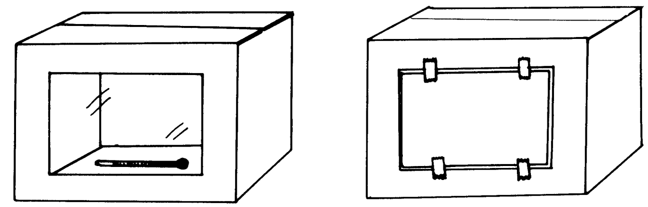
21.2 Catch the Sun!: Instructions

In this activity, you will use cardboard boxes to construct two "homes." Each will have a plastic "window." One home's window will be covered with cardboard. You will then place your homes in the sun and record the air temperature inside of each for 30 minutes.

Your teacher will explain how to construct your "home."

When you cut the cardboard out to form the windows, save one piece to use as a window cover.

The thermometer can either be placed in the home where it is visible through the window, or it can be suspended in the "ceiling" (box top) in such a way that the bulb is inside the home near the ceiling and the temperature can be read from the outside of the box.



When the thermometer has stabilized, record the starting temperature in each "home." Then place both "homes" in the sun with the windows facing toward the sun. Be sure to place them in a place where they won't become shaded before they have been in the sun for 30 minutes.

Record the temperature of each house every 5 minutes for 30 minutes.

GRADES 7-9

The Energy Sourcebook

TVA Environmetal Research Center
P.O. Box 1010, CTR 2C
Muscle Shoals, AL 35662-1010
205-386-2714
205-386-2126 (fax)

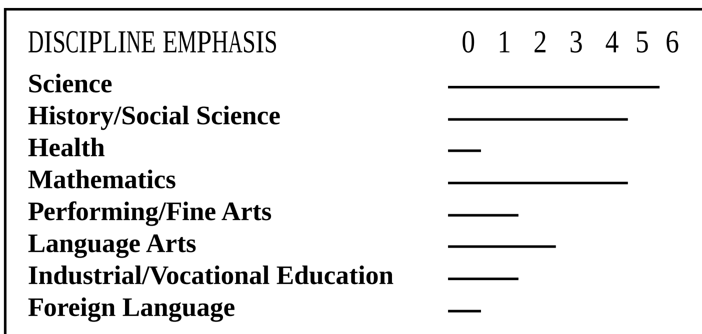
$35 each; 1992.

Grades 7-9

The “Sourcebook” includes six chapters of six to nine activities each; activities can stand alone or be combined with lessons from different chapters.

REPORT CARD

Overall Grade	**A**
General Content	**A**
Presentation	**A**
Pedagogy	**A-**
Teacher Usability	**A**
Energy Content	**A**



COMMENTS

General Content
Subtle wit and thoroughness characterize these appropriately developed lessons. Good activities, good extensions, includes lessons on sustainability.

Presentation
Features concise, well organized lessons that list objectives, times, adequate background, interdisciplinary connections, and materials all on the front page.

Pedagogy
Good diversity in instructional strategies. Lessons exercise higher level thinking skills and problem solving. Provides good mix of classroom and field activities and wide variety of discovery-based activities.

Teacher Usability
Many materials required for some units/ lessons. Excellent and copious background for teachers. Objectives (most in behavioral terms) with each lesson.

Energy Content
Thoroughly develops each major facet of energy.

CONSTRUCTION AND OPERATION OF A STEAM TURBINE MODEL (continued)

5. NOTE: To simplify this demonstration, set the flask on a hot plate rather than burning coal to heat the water. If you use a hot plate, make sure the students understand that the heat from the hot plate functions just as the heat from either a burnable fuel or nuclear fuel functions in a power plant.

II. Operation of the model

CAUTIONS: Wear goggles! Use an operative fume hood. Practice safety rules! Make sure the opening of the tube is directed away from you and towards the turbine. Steam can cause serious burns.

A. Light the burner (or turn on the hot plate) and heat the crushed coal. When the coal begins to burn, turn off the burner or hot plate.

B. Direct the steam emerging from the end of the nozzle toward the turbine blades, and observe as the turbine spins.

III. Questions to ask the students

A. Have the students trace the transfer of energy from the coal to the turbine. Make sure they can identify the following:

1. Where energy changes from potential to kinetic energy.
2. Where chemical energy is found.
3. Where mechanical energy is found.
4. Where heat energy is found.
5. Where light energy is found.

(Modify your questions if you use a hot plate rather than coal.)

B. Ask the students what happens to the chemical energy from coal when we burn it to operate this model.

C. Have the students describe how the production of electrical energy relates to this model.

Teacher

CONSTRUCTION AND OPERATION OF A STEAM TURBINE MODEL (continued)

5. NOTE: To simplify this demonstration, set the flask on a hot plate rather than burning coal to heat the water. If you use a hot plate, make sure the students understand that the heat from the hot plate functions just as the heat from either a burnable fuel or nuclear fuel functions in a power plant.

II. Operation of the model

CAUTIONS: Wear goggles! Use an operative fume hood. Practice safety rules! Make sure the opening of the tube is directed away from you and towards the turbine. Steam can cause serious burns.

A. Light the burner (or turn on the hot plate) and heat the crushed coal. When the coal begins to burn, turn off the burner or hot plate.

B. Direct the steam emerging from the end of the nozzle toward the turbine blades, and observe as the turbine spins.

III. Questions to ask the students

A. Have the students trace the transfer of energy from the coal to the turbine. Make sure they can identify the following:

1. Where energy changes from potential to kinetic energy.
2. Where chemical energy is found.
3. Where mechanical energy is found.
4. Where heat energy is found.
5. Where light energy is found.

(Modify your questions if you use a hot plate rather than coal.)

B. Ask the students what happens to the chemical energy from coal when we burn it to operate this model.

C. Have the students describe how the production of electrical energy relates to this model.

P-28

Canadian Energy Issues

Mike Bergin
Ottawa Board of Education
56 Herridge St.
Ottawa, Ontario
Canada K1S 0G9
613-733-4860 (bus)
613-233-5051 (home)

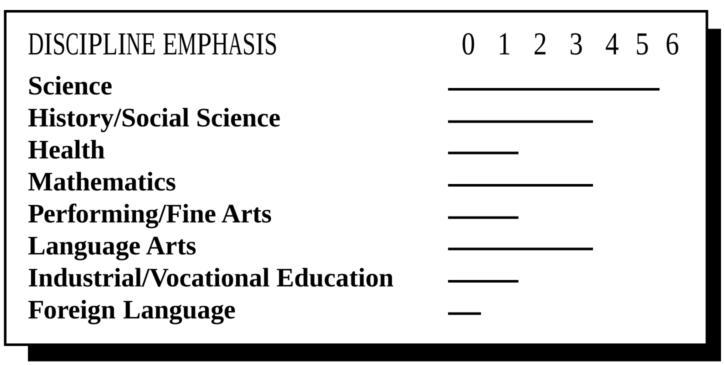
$20 per copy; 267 pages, 1992.

Grade 9

This unit is designed to be taught by a team of core subject teachers working with the same group(s) of students in a particular block of time in the school day.

REPORT CARD

Overall Grade	**A**
General Content	**A+**
Presentation	**A-**
Pedagogy	**A-**
Teacher Usability	**B**
Energy Content	**A**



COMMENTS

General Content
Very strong interdisciplinary component. Takes students from understanding major energy resources to visualizing a sustainable future through improved energy efficiency and alternative energy sources.

Presentation
Activities tend to look alike—one worksheet after another (even though the students are thinking!).

Pedagogy
Encourages higher order thinking skills. Addresses affective as well as cognitive domain. Imbedded assessment.

Teacher Usability
Appendices provide useful organizational strategies. Uses Canadian-specific statistics. Items available in French.

Energy Content
Extensive treatment of renewables.

Fusion

FUSION ENERGY TECHNOLOGY

* Tremendous challenge to harness and control power of nuclear fusion.

* Only natural occurrence is found in sun and stars. This is due to the following conditions:
  - strong forces of gravity
  - temperature of 17 x 10^6 °C

In these conditions, hydrogen atoms collide and fuse forming a helium atom, thus creating energy in the form of light and heat.

* Man made fusion requires isotopes of hydrogen-deuterium and tritium because this combination of hydrogen burns at a much lower temperature than the sun.

The ignition temperatures of various hydrogen isotopes

Fusion Reaction	Energy of Reactants J/g (X 10^{10})	Ignition Temperature ^{0}C (X10^6)
D + T - ^{4}He + n	16.9	77
D + D - ^{3}He + n	4.0	773
D + D - T + p	4.8	386
D + ^{3}He - ^{4}He + p	17.7	620
D + ^{10}B - 3^{4}He	3.2	2300

A LAYMAN'S GUIDE TO HOW FUSION WORKS

E, as Einstein explained, equals mc^2. And that deceptively simple little equation explains why one gram of matter has an energy content equivalent to burning 9,500 litres of gasoline.

Energy equals mass times the speed of light multiplied by itself. That means even a tiny mass contains tremendous energy reserves waiting to be tapped.

And fusion technology, proponents say, is just the key to unlock the reserves.

According to the theory, if two tiny atomic nuclei could be forced to join together, they would produce a new nucleus that would be slightly lighter than the sum of the two parts.

The excess mass would be released as energy. The energy could be harnessed and used to light and heat our homes. The trouble is that nuclei, those tiny cores of atoms, have a strong repulsion for each other because they both carry positive charges. That means energy is needed to squeeze them together.

So far, the elusive goal of scientists is to reach the magical "breakeven" point, where more energy is created than is spent on fusing the nuclei.

Above the breakeven point, the reaction "sustains" itself. That means it creates enough energy to keep going on its own.

In experimental reactors such as the

Fusion (cont'd)

Tokamak in Varennes, Que., researchers invest electrical energy to press two hydrogen atoms together.

But according to contemporary fusion theory, the best fuel for a future commercial reactor is a half- and-half mixture of deuterium and tritium, two heavier forms of hydrogen.

Unlike the hydrogen nucleus, which contains one positive proton, deuterium has one proton and one uncharged neutron. It can be extracted from seawater and is not radioactive. Tritium, however, is radioactive. It contains one proton and two neutrons.

When deuterium and tritium fuse, with their total of five nuclear components, they produce a helium nucleus (two protons and two neutrons), a spare neutron and - most importantly - tremendous energy.

The new helium atom itself is energized, bouncing around and reinvesting some of its energy into continuing the fusion process.

When its energy is used up, it becomes a harmless waste product.

* Two types of reactors under development

  1. Magnetic confinement
     - Problems - ignition temperature
       - leakage of charged particles
       - energy input exceeds energy output.

  2. Tokamak reactor
     - Facts for operation
       *Temperature - 100 x 10^6 °C
       *Time - 1 second
       *Density - 10^{14} atomic particles per cm^3
       *Fuel - frozen pellet of deuterium-tritium (smaller than pin head)

* Goal - increase density of fuel pellet 10,000 times normal density of matter
  - pellet implodes in picoseconds (.10^9 sec.)

* Energy Released - 17.6 x 10^6_eV (equivalent to few sticks of dynamite)

* Heat absorbs into lithium blanket producing heat.

GRADES 7-9

Sustainable Energy Issues

Mike Bergin
Ottawa Board of Education
56 Herridge St.
Ottawa, Ontario
Canada K1S 0G9
613-733-4860 (bus)
613-233-5051 (home)

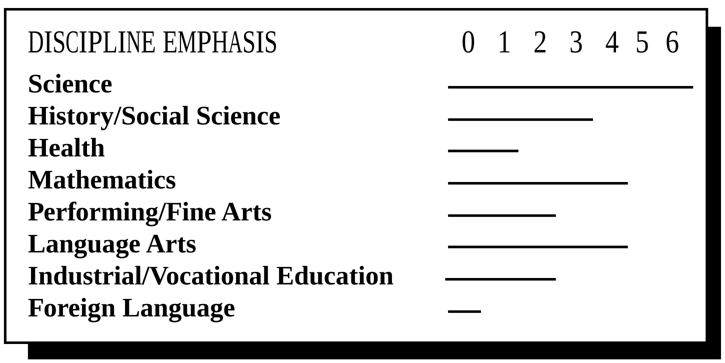
$20 per copy; 173 pages, 1992.

Grade 7

This core program incorporates family studies, art, music, drama, computers, and technology into core subject areas to present an integrated seventh grade unit.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**A-**
Pedagogy	**A**
Teacher Usability	**B+**
Energy Content	**A**



COMMENTS

General Content
Empowering to students. Puts activities in a context students can understand. Often presents both sides of an issue, usually given in context. Integrates across the disciplines.

Presentation
Fact sheets provide accurate, easily accessible information. Quality ditto pages including maps.

Pedagogy
Excellent scope of evaluation strategies. Some sections lack hands-on activities. Exhibits great diversity in instructional strategies. Addresses the affective and cognitive domains.

Teacher Usability
Describes cooperative learning strategies. Objectives not written to specific lessons. Teacher background is mingled with student sheets. Some sections available in French.

Energy Content
Covers many energy topics with some depth.

Geothermal Energy

For each active volcano there are probably hundreds of areas in which molten rock has pushed upwards to within a few kilometres of the surface of the Earth. I may take millions of years for such underground magma chambers to cool, for the solid rock that surrounds them also insulates them; rock is a very poor conductor of heat. What stores the heat in pockets and, thus turns a geological accident into a geothermal resource, is water. In tapping the Earth's heat, one is not mining rock, but water, and thus a convenient way to classify different kinds of geothermal resources is by "hotness" and "wetness".

1. Steam Reservoirs

Water permeating fissures and cracks in rocks which are heated to high temperatures (ranging around 235°C), may, depending on the pressure, turn to steam. If it does, and if this underground reservoir is sealed above by a lid of impermeable rock, it will become a kind of pressure cooker. The water will be pushed down by the pressure of the steam, so that if a hole is drilled through the lid, dry steam—under pressure and superheated—will escape. This dry steam is an excellent medium for driving steam turbines an, in turn, electrical generators. Reservoirs of dry steam, though, are rare. Only four are now exploited.

2. Hot water Reservoirs

Water heated up to high temperatures will not necessarily turn to steam if confined under high pressure. However, once this superheated water is exposed to air pressure, it will "flash", with a blast of noise. Less than a third of the water will actually vaporise. The majority will stay as a boiling hot liquid. This is a wet steam reservoir, the kind that is tapped for energy at most of the world's geothermal power plants. (Interestingly enough, lowering the pressure of a hot water reservoir in New Zealand turned it into a dry-steam field.)

3. Warm Water Reservoirs

When the temperature lies between 60°C and 140°C, as it does in the warm water near and under Reykjavik, electricity cannot be generated—not, at any rate, by means of conventional technology. But like an open pot used to warm rather than boil water, this kind of reservoir is tapped for heating.

4. Hot Dry Rocks

Concentrations of heat close to the surface are common not only in volcanic regions. Elsewhere, they may be due, among other causes, to locally high levels of radioactivity. But if the heated rocks are dry—either because they are solid, and thus hold no water, or because they have no underground supply of water—they are about as useful as a hot but empty kettle. To tap their heat, water must somehow be added, and to do this requires complex, and as yet imperfectly developed technology.

5. Sedimentary Reservoirs

In volcanic zones, heat flows are usually concentrated. In sedimentary basins, heat from diffuse flows is often accumulated and stored in the form of warm water, creating an entirely different kind of geothermal resource. For example, if the average temperature at a depth of 3 km is 75°C, and if it were covered by an insulating blanket of impermeable rock, then it would slowly collect heat until all its water has reached this temperature. In France, Hungary, the Soviet Union and other countries, warm water from sedimentary rocks is heating buildings and greenhouses. This kind of geothermal resource lies beneath much of the world's habitable land.

Exploring Energy #3, Geothermal Energy, S. McCutcheon, Ministry of Supply and Services pp.10-11.

An Experiment With Geothermal Energy

Problem:

- can steam produce mechanical energy?

Hypothesis:

- a jet of steam can turn a simple windmill.

Materials:

- heat-proof flask with a two-holed stopper
- eye dropper and bent glass tubing
- small block of metal
- small propeller
- bunsen burner or hot plate
- tongs, safety glasses, heat-proof gloves.

Procedure:

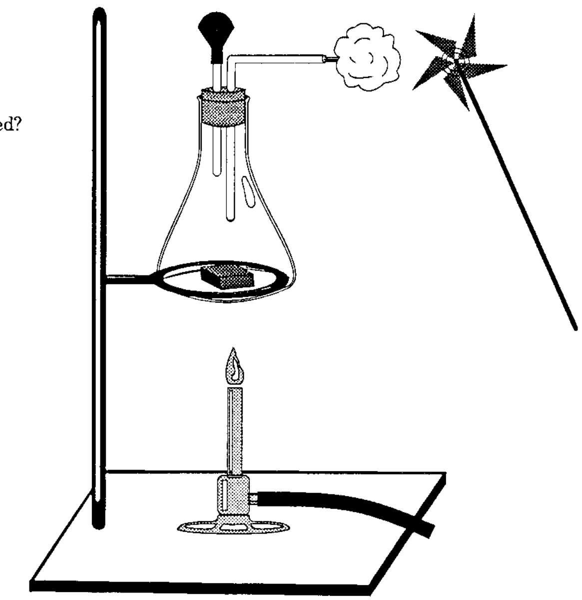
- put on the safety glasses and gloves.
- place the block of metal carefully in the bottom of the beaker using the tongs.
- set up a bunsen burner and heat the block of metal.
- arrange the stopper and glass tubing as shown in the diagram.
- place the propeller close to the end of the bent glass tubing.
- carefully allow water to drip onto the hot metal.

Observations:

- write down what happens.

Conclusions:

- how might the energy be used?



Global Energy Issues

Mike Bergin
Ottawa Board of Education
56 Herridge St.
Ottawa, Ontario
Canada K1S 0G9
613-733-4860 (bus)
613-233-5051 (home)

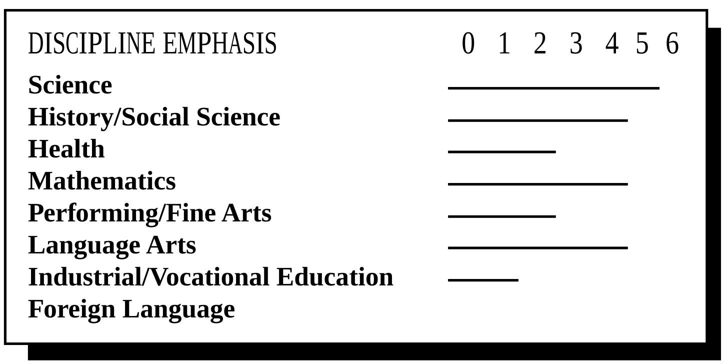
$20 per copy; 195 pages, 1992.

Grade 8

This curriculum provides opportunities for cooperative learning, independent study, and development of attitudes and values through strategies based on learner-centered instruction.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**B+**
Pedagogy	**A-**
Teacher Usability	**A-**
Energy Content	**A**



COMMENTS

General Content
Sound, integrated approach. Addresses the development of attitudes and values. Better for language arts, social studies, or math core.

Presentation
Seems to be fairly student centered. Energy issue fact sheets provide relevant information.

Pedagogy
Excellent evaluation section which includes authentic assessment. Good diversity in instructional strategies—small groups and independent work.

Teacher Usability
Items available in French. Outcomes at the start of each unit, not with each lesson. Includes teaching technique ideas. Good background information for teacher.

Energy Content
Comprehensive treatment of human energy issues.

Additional Evaluator Thoughts
The whole idea of these two units is great: it keeps kids active and motivated.

The House of the Future

Materials:

- Pictures of solar houses
- Art materials
- Cardboard
- Black hose or PVC tubing
- Black paint
- White glue
- Thermometer
- Aluminium foil
- Clear plastic wrap or clear acetate

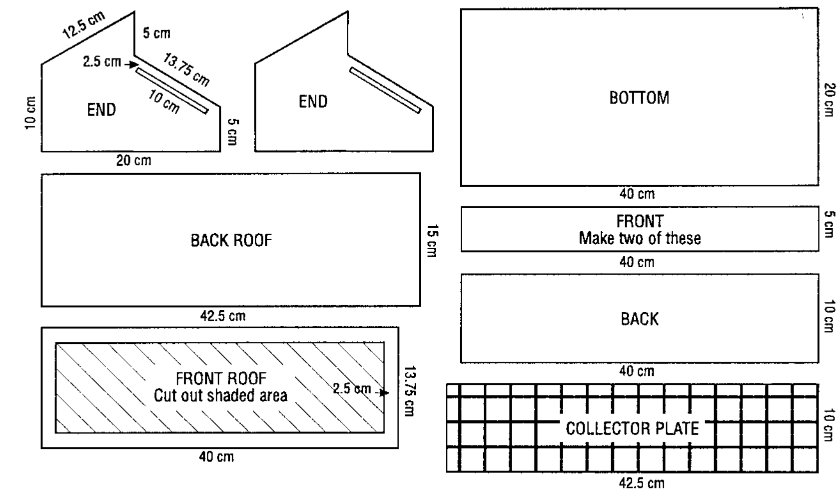
Procedure:

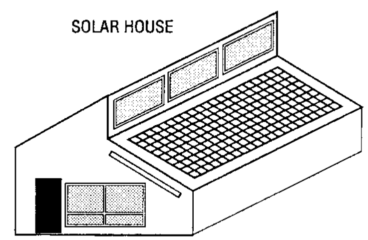
- Brainstorm as many methods of conserving energy in the home as possible (such as protected entrances, wind breaks, thermal windows, etc. ...)
- Decide which methods you'd like to use in a new house you are going to design and build. Find and bring in pictures of solar homes.
- You are going to draw, paint or create models of your solar home incorporating the energy conservation measures you have decided on—plus active and/or passive solar heating. You may wish to place the house in an energy-efficient landscape.
- If you'd like, you can build from the plans below:

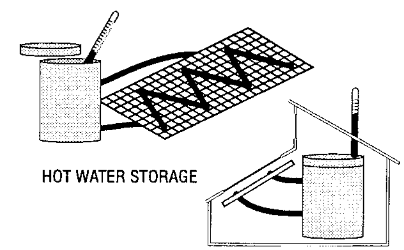
Plans for a Solar house:

- Transfer the plans on the following page onto strong cardboard.
- Cut out each of the pieces *carefully* using scissors or an X-acto knife.
- Assemble all the pieces except the collector plate, front roof and back roof using tape and white glue
- For greater insulation, double the thickness of all the walls and the roof.
- Cover the front roof section with plastic wrap or clear acetate.
- Cover the collector plate with aluminium foil and paint the foil with non-reflective black paint.
- Mount the collector plate inside the house through the slots cut 2.5 cm below the front roof.
- Fasten the front roof in place.
- Measure *inside* the walls where the back roof will be fitted and cut a piece of cardboard to fit inside this space. Glue this cardboard to the inside of the back roof to hold the roof in place. The roof must fit tightly to ensure heat doesn't escape.
- Paint the house and add windows and doors.
- Use a thermometer to record air temperatures inside the house.
- A solar storage tank can be created from an insulated cup (with lid) and copper or plastic pipe.
- Punch two holes for the pipe and one for the thermometer into the cup. You can put all the holes in the lid, but the pipe to the bottom of the collector must go down to the bottom of the cup and the other must be close to the top.
- Fill the can and the pipe with water. Be sure there are no air bubbles in the system.
- Take the temperature of the water right after you set the collector up. Record temperatures every 10 minutes afterwards.
- Create a display of your results.

Solar House Plans







GRADES 7-9

The California CLASS Project

California Department of Education
Bureau of Publications
P.O. Box 271
Sacramento, CA 95812-0271
916-445-1260/1-800-995-4099
916-323-0823 (fax)

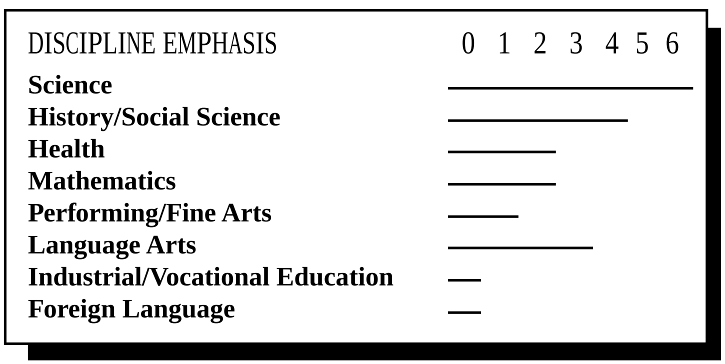
Item #9939, $29 plus tax, plus $4.95 shipping and handling; 373 pages, 1992.

Grades 7-9

This program is a series of 33 classroom-ready lessons presented in six thematic units.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**B+**
Pedagogy	**A-**
Teacher Usability	**A**
Energy Content	**B+**



COMMENTS

General Content
General overview to energy issues. Specific to California plants and animals.

Presentation
Highly organized curriculum with specific, easy to use activities. Good quality reproducibles. Lots of variety in the types of activities offered.

Pedagogy
Inquiry based and investigation oriented. Stresses reading with little or no hands-on involvement.

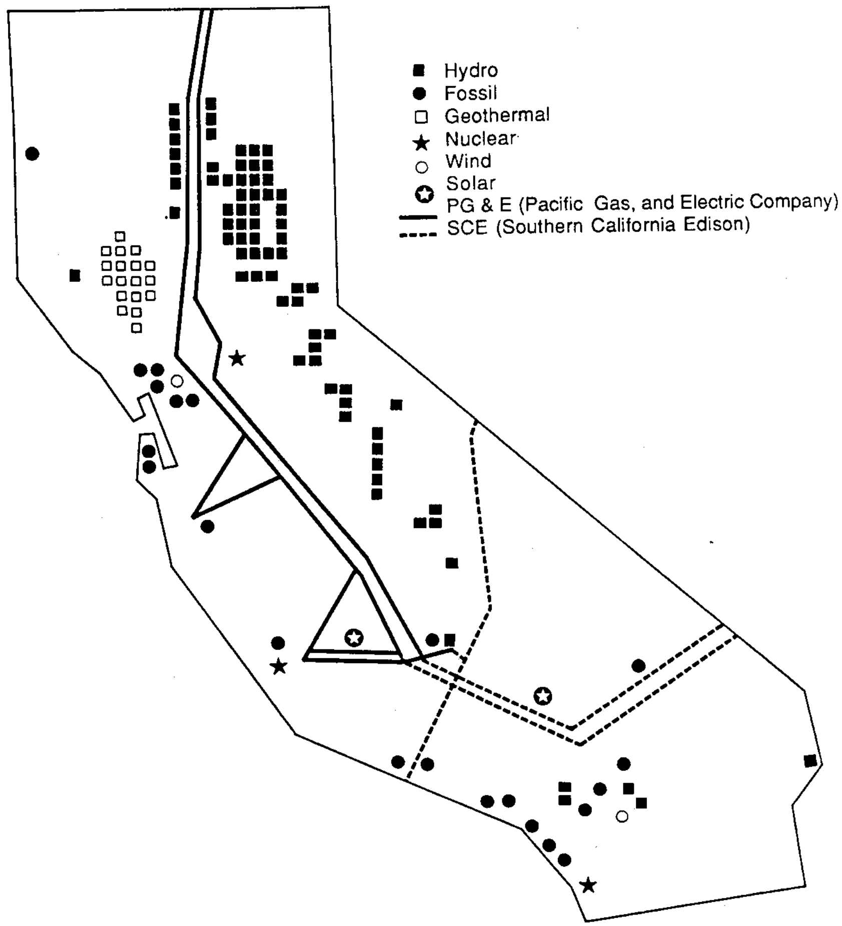
Teacher Usability
Includes California framework correlations. Well written, measurable objectives.

Energy Content
More an overall environmental curriculum with only a small percentage directly dedicated to energy resources. Covers transportation as an energy item.

Additional Evaluator Thoughts
Clearly a superlative, top-of-the line curriculum.

TRANSPARENCY C

MAP OF MAJOR ELECTRICAL GENERATING STATIONS IN CALIFORNIA



STUDENT WORKSHEET #1

POWER PUZZLE QUESTIONS

1. Near what city or town are your community's power plants located? ______________________________

2. What company operates them? ______________________________

3. What natural resources do the power plants use? ______________________________

4. Are these resources renewable or nonrenewable? ______________________________

5. Where does your electrical utility company get this resource? ______________________________

6. What power plants are used for regular electrical base load? ______________________________

7. From what source does the company acquire electricity during peak loads? ______________________________

8. How does the electricity get from the power plant to your home? ______________________________

9. List 2 benefits and 2 possible problems with your power plants. ______________________________

10. What would be an ideal energy source for your community? Give reasons for your answers.
____

Issues, Evidence and You

Sargent-Welch
P.O. Box 5229
Buffalo Grove, IL 60089-5229
1-800-727-4368
1-800-676-2540 (fax)
http://www.sargentwelch.com

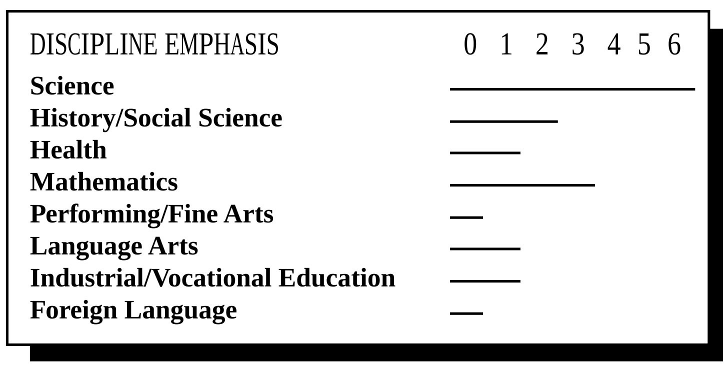
$4,028.99 (full year course which includes materials kit with equipment for five classes of 32 students, teacher's manual, and 32 sets of student books - replacement books available); 1995.

Grades 7-12. Evaluation based on review of materials for grades 7-9.

A diverse educational program highlighting science and its uses in the context of societal issues.

REPORT CARD

Overall Grade	**B+**
General Content	**A-**
Presentation	**B+**
Pedagogy	**A**
Teacher Usability	**A-**
Energy Content	**B**



COMMENTS

General Content
Complete with many unique, fun, relevant activities. Highly technical orientation for this grade level could provide sound basis for subsequent environmental education units.

Presentation
The large size of the notebook may turn teachers off this curriculum. Detailed teacher directions. Good photos and historical perspectives.

Pedagogy
Encourages students to use higher order thinking skills. Embedded assessment.

Teacher Usability
Small amounts of many things must be gathered for most labs. Time intensive.

Energy Content
Discusses the physics of electricity.

Electrical Appliances: Then and Now Survey

Introduction

By conducting this survey, you will collect data about the number of appliances you have in your home today, compared with the number of appliances your parents or guardians had at home when they were your age. The data will show any changes in the use of appliances and energy.

Challenge

Take a look at the appliances listed on the survey distributed by your teacher. Guess how many you have in your home right now. Now conduct the survey and find out!

Electrical Appliance Survey

Electrical Appliances: Then and Now Survey

Introduction

By conducting this survey, you will collect data about the number of appliances you have in your home today, compared with the number of appliances your parents or guardians had at home when they were your age. The data will show any changes in the use of appliances and energy.

Challenge

Take a look at the appliances listed on the survey distributed by your teacher. Guess how many you have in your home right now. Now conduct the survey and find out!

Activity 4[illegible]

Energy, Economics and the Environment—Middle School

Indiana Department of Education
Office of Program Development
Attn: Rose Sloan
Room 229, State House
Indianapolis, Indiana 46204-2798
317-232-9186
317-232-9121 (fax)

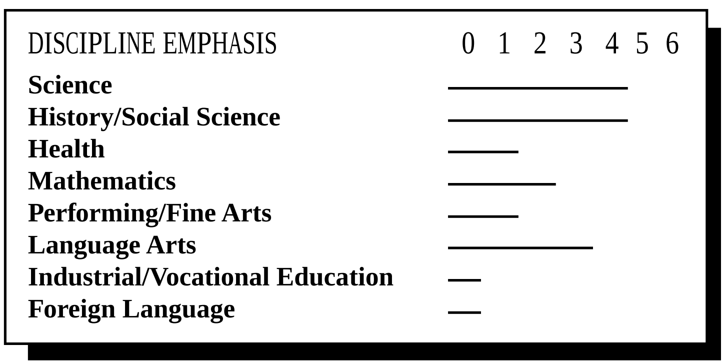
$8 per copy; 120 pages.

Grades 7-9

This curriculum provides a conceptual framework for analyzing energy and environmental issues, and provides teachers with a set of motivational, interdisciplinary teaching units centering on these important issues.

REPORT CARD

Overall Grade	**B+**
General Content	**A**
Presentation	**B+**
Pedagogy	**B+**
Teacher Usability	**B**
Energy Content	**B**



COMMENTS

General Content
Relevant scenarios allow the decision-making process to flourish. Highly integrated; acknowledges the importance of economics.

Presentation
A good, challenging, thought-provoking approach--intriguing!

Pedagogy
Incorporates a decision-making model which empowers students. Encourages higher level thinking skills. Requires much independent work of students; many may need more direction.

Teacher Usability
Adequate background for teachers. Well written, measurable objectives.

Energy Content
Not necessarily energy intensive. Does not address renewable energy sources in depth.

The Case of the New Power Plant

Student Directions:

You are members of the city council in the growing community of Ourtown. You must evaluate several proposals for dealing with a growing shortage of electricity. After evaluating the arguments by each group, fill in the decision worksheet and grid, using the five step, decision-making process to decide which recommendation to accept.

Scenario:

Ourtown is enjoying a period of economic growth that most cities can only dream about. It has grown from a sleepy little rural town to a city with plenty of jobs and a high standard of living. Luckily, it has avoided the big-city problems with crime and pollution that plague many other communities during their boom periods. It has become a place people want to live and a place where businesses want to locate. As a result, the population has doubled during the past 20 years, yet, electricity is produced in a power plant built in 1947 for a much smaller population. During a heat wave last summer, so many air conditioners were turned on that power outages occurred all over town. The situation is expected to get worse in the future.

While sitting in the local barber shop waiting for a hair cut, Mr. Alvarez, President of the Ourtown Chamber of Commerce, complains loudly to everyone within earshot that without a new power plant, the city can forget about economic growth or even having sufficient capacity to meet residents' current needs. He argues that the cheapest way to meet the community's energy demand is by building a new coal-fired power plant.

The barber, Sally Friedman, responds that nuclear power would be more economical, particularly, if we take into account the environmental costs of both producing and using fossil fuels. "The safety record of nuclear power is better than that of other energy sources," states Ms. Friedman. "We have built so many fail-safe mechanisms into our nuclear plants that the odds against a major accident are astronomical." Mr. Alvarez counters that coal is our most plentiful energy resource, and that modern power plants can burn coal economically and in an environmentally responsible manner. Mr. Alvarez adds, "Even though the odds are heavily stacked against a major incident at a nuclear power plant, if it does happen, it will be catastrophic. Are we prepared to take that risk?"

Fred Simpson, who manages the local Dairy Queen, reminds the group that his restaurant is solar powered. "Why can't we use some of that vacant land just west of town to build giant solar collectors to generate power to meet the city's growing energy demand?" asks Fred. "This would be essentially free electricity from the sun waiting for us to take it. And unlike the case with nuclear power, we wouldn't have any disposal problem with dangerous radioactive waste."

Ben Johnson, who is active in several environmental groups, argues that people simply need to cut back, that their energy consumption is wastefully high. He points out that just setting our thermostats a few degrees higher in the summer and lower in the winter would save enough energy to avoid a shortage without the environmental cost of building new facilities for generating electricity. "Further," Mr. Johnson adds, "we don't need those ridiculously long hours of operation at the mall. Why don't we just require stores to reduce their hours of operation? Surely 12 hours per day is enough." Mr. Johnson reminds the others that any energy source involves some costs. For example, solar collectors are expensive to build, take a lot of valuable space that could be used for other purposes and produces energy only on sunny days.

Ms. Friedman responds, "Ben, that sounds great, but what about people whose health prevents them from setting back their thermostats? And how about my daughter and her friends, who would rather give up food and shelter than cut back on trips to the mall? How do we decide for other people which of the "needs" are more important?"

The discussion dies down without the group reaching a consensus.

Hot Water and Warm Homes from Sunlight

LHS GEMS
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200
510-642-7771
510-643-0309 (fax)
http://www.lhs.berkeley.edu

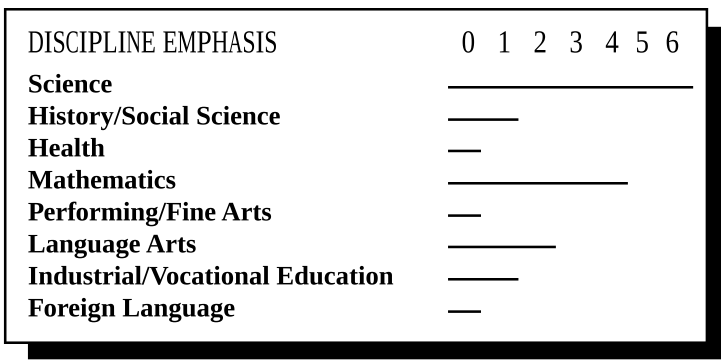
$13.50 each; 69 pages, 1995.

Grades 4-8

Students conduct straightforward, controlled experiments to find out how sunlight can best be used to heat houses and water.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B+**
Pedagogy	**B+**
Teacher Usability	**A-**
Energy Content	**C+**



COMMENTS

General Content
Good projects, documentation, and discussion steps. Elementary solar energy experiments with detailed instructions for teacher.

Presentation
Reproducibles are clear and easy to follow. Good dittos to use as follow up or for demonstration.

Pedagogy
The curriculum actively solicits comments and criticisms in order to produce a more helpful model. Assessment is limited.

Teacher Usability
Summary outlines at the end of the curriculum provide quick reference. Includes a list of teacher's guides related to additional topics.

Energy Content
Practical development of several concepts related to solar energy applications.

ALAN'S COOKER

WHAT YOU NEED:

- ❒ 1 sheet of foilboard or other reflecting surface, 18" x 44" (46 cm x 12 cm) for the parabolic reflector
- ❒ 1 sheet of reflecting surface, 12" x 40" (30 cm x 100 cm) for the bottom reflector
- ❒ 1 sheet of cardboard, 12" x 40" (30 cm x 100 cm) for top reinforcing piece
- ❒ 1 push pin
- ❒ 1 pencil
- ❒ 1 scissors
- ❒ 16 paper fasteners
- ❒ 1 cooking vessel, such as one of the following:
  - — a dark-colored pot or pan with clear or dark lid
  - — a clear glass jar with clear or dark lid
  - — a clear Pyrex® pot with lid
- ❒ black metal supports for the cooking vessel; these can be empty tin cans painted black (small tomato sauce or tuna cans are about the right size)
- ❒ (*optional*) 2 edge sticks, ¼" x 12" dowels

Construction

1. Duplicate pages 46–49. With scissors, cut along the template lines. Tape the four template pieces together to make a single large template, as shown in Figure 1.

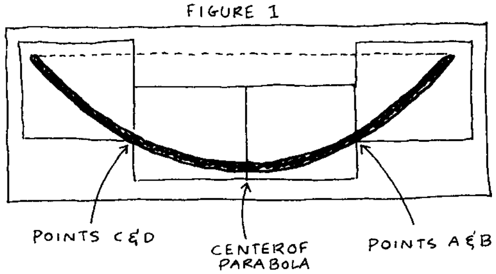
2. Using the template, mark a parabola on the top reinforcing piece and cut it to make the shape shown in Figure 2.

3. Draw two lines parallel to the long edges of the parabolic reflector, 1" (2.5 cm) from each edge. Cut slits in from the long edges to the line at 1" intervals as shown in Figure 3.

4. Fold the resulting tabs up. Line up the parabolic reflector to the parabolic curve on the top reinforcing piece. Tape the tabs to the top reinforcing piece to hold the parabolic reflector in place, as shown in Figure 4.

5. Punch small holes through a few of the tabs as close to the fold lines as possible. Make the holes go all the way through the top reinforcing piece. Use a push pin to punch the holes, then enlarge the holes with a pencil tip. Secure paper fasteners through the holes, as shown in Figure 5.

FIGURE 1



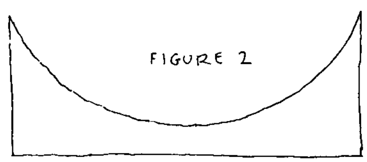
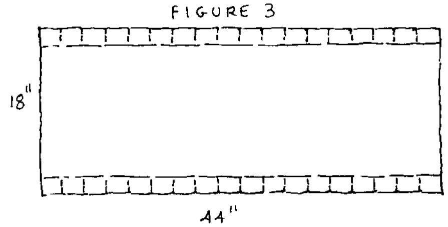


FIGURE 2

FIGURE 3



ALAN'S COOKER

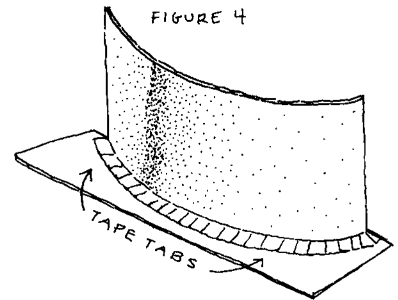
6. Lay the parabolic template on the bottom reflector and temporarily tape it in place. Lining up the parabolic reflector with the template, tape the tabs to the bottom reflector and secure with paper fasteners as in steps 4 and 5. Then remove the template.

7. (Optional) Tape edge sticks to each short edge of the parabolic reflector.

Note: To make a bigger cooker, make a larger template by plotting a number of "x" and "y" points according to the following formula for a parabola:

$$y = \frac{x^2}{4f}$$

(where "f" is the focal length, or distance from the parabola to the cooking vessel)



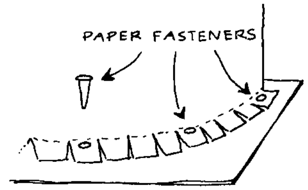


FIGURE 5

Using the Cooker

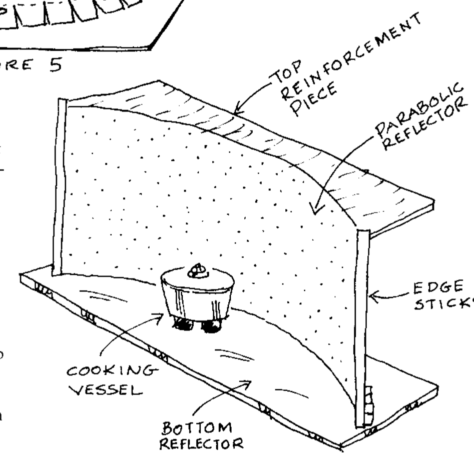
1. Orient the parabolic reflector so it faces the sun. On grassy or uneven ground, it is helpful to put the cooker on a wooden board. Put three identical blackened tin cans about 10" (25 cm) in front of the center of the parabolic reflector.

2. Put a cooking vessel containing food on top of the cans. It will start getting hot! You can make rice, steam vegetables, warm canned foods, boil hot dogs, and cook many other foods.

3. Move the cooker about every 15 minutes to keep it facing the sun.

4. Of course, the amount of time required to cook a particular food varies. A solar cooker can take up to twice as long as the same task would take on a standard stove.

5. The solar cooker can be disassembled for easy carrying and storage.



GRADES 7-9

Electric Vehicle Classroom Kit

EV Media
612 Colorado Ave., Suite 111
Santa Monica, CA 90401
310-394-3980
310-394-3539 (fax)

Kits start at $139.50 (121 page teacher book,
35 student booklets, and five model car kits); 1996.

Grades 7-12. Evaluation based on review of materials for grades 7-9.

The teacher's book provides information and suggestions for conducting a unit; the unit is built around a sequence of activities, some of which are optional.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B**
Pedagogy	**A-**
Teacher Usability	**B**
Energy Content	**B-**

DISCIPLINE EMPHASIS	0 1 2 3 4 5 6
Science	
History/Social Science	
Health	
Mathematics	
Performing/Fine Arts	
Language Arts	
Industrial/Vocational Education	
Foreign Language	

COMMENTS

General Content
Students discuss the integration of this one energy technology into society and may realize that issues are not clearly defined.

Presentation
Fun activity! Good pictures for junior high kids—good information in a current science format.

Pedagogy
Assessment tied to every lesson. Really addresses diversity among students.

Teacher Usability
Good background for teachers. Good teacher background materials. Excellent student materials.

Energy Content
Helps students analyze the problems of combustion engines and explore one possible solution.

Additional Evaluator Thoughts
Fun project — students would love to do this.

Dealing with the Dilemma

Overview

This lesson and the following one, which conclude the unit, are meant to help students relate what they have learned about electric vehicle technology to the urban air pollution problem and their analysis of their families' use of transportation.

Processes

Communicate.
Compare.
Relate.
Infer side effects of actions.

Objectives

Experience
✓ Grappling with a real, complicated problem that has no obvious solution.
Know
✓ Every action has side effects.
Are Able to Do
✓ Present a reasoned argument.

Assessment

Evaluate the student's answers to the worksheet and the quality and extent of participation on class *and team* discussion.

Conducting the lesson

Recall for the class how the unit began, with our need for transportation. But our transportation system produces air pollution.

Divide the class into teams, give each team a copy of the worksheet on the next page. After the team has discussed a question among themselves, each member of the team is to write his or her answer to the question on a separate sheet of paper. An individual's answer may agree with that of most of the other members of the team, or it may not. Depending on how the teams' progress and how well the discussions within the groups are going, you may want to allow the rest of the period for this activity.

When the teams have finished, hold a class discussion. Go through the questions, discussing each one and soliciting various views. It is sometimes helpful to ask, "Is there anyone who didn't agree with the other members of their team?"

Some points to consider in regard to the questions:

1. "No" is not necessarily a wrong answer.

2. Be sure the discussion doesn't only mention health effects. There are also economic effects (deterioration of materials) and indirect effects, such as loss of industries that prefer to locate in cleaner areas.

3. Students often say "everyone" is responsible, but don't leave it at that. It is equally true that "everyone" is responsible for traffic safety, but suppose only "everyone" were responsible. Would the roads be safe?

4. This question can be answered technically. What kind of data would be necessary and how could it be gathered?

5. When several "major advantages" or disadvantages are proposed, ask students to rank them.

11. Press students to go beyond describing their projects to explaining why they chose that project.

12. This question is one of philosophy.

13. Ask what other effects the measure would have that would not be related to air pollution.

What Do We Think?

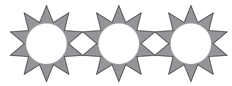
1. Is air pollution a problem we need to do anything about? yes no
2. If urban air pollution gets worse, who will suffer?
3. Who is responsible for controlling urban air pollution?
4. Could electric cars help cities with an air pollution problem? yes no
5. Compare using electric cars with two or three other measures that would reduce urban air pollution. Name the major advantage and the major disadvantage for each measure.
6. Compare electric cars with gasoline-powered cars. What are some advantages and disadvantages of each?
7. Could an electric car meet the transportation needs of your family if it was your only car? yes no
   If it were a second car? yes no
8. What percentage of the members of your team think an electric car would do as a first or second car for their family?
9. Make a prediction. Will city dwellers buy many electric cars in the next five years? Why?
10. To increase the appeal of electric cars to buyers, what characteristics of electric cars would benefit the most from improvement? Price range weight styling availability of cars availability of chargers
11. If you were in charge of a large budget to be spent on improving electric cars, what projects would you finance?
12. Should governments promote the use of electric vehicles? yes no

If they should, which (if any) of the following actions should they take (check any that apply)

❑ force manufacturers to build electric cars
❑ special parking privileges for electric vehicles
❑ reduced tolls on bridges and toll roads
❑ require garages in new homes be wired for a charger
❑ allow electric cars to use car pool lanes on freeways
❑ tax credits or reduced registration fees

13. What method or methods of reducing urban air pollution do you personally prefer, and why?

Geothermal Energy



Geothermal Education Office
664 Hilary Drive
Tiburon, CA 94920
415-435-4574 /1-800-866-4436
415-435-7737 (fax)
http://www.geothermal.marin.org

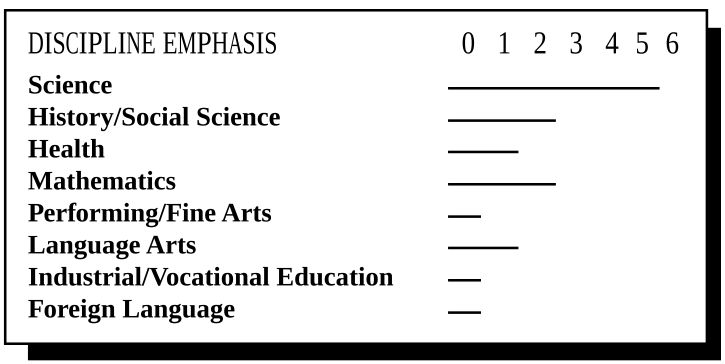
$8 per curriculm (includes shipping and handling), New video: Geothermal Energy: A Renewal Option now available with free lesson plans. Free classroom materials. Speakers can also be arranged.

Grades 4-8

This unit describes geothermal energy in the context of the world’s energy needs, addressing renewable and nonrenewable energy sources with an in-depth study of geothermal energy.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B**
Pedagogy	**B**
Teacher Usability	**B**
Energy Content	**B**



COMMENTS

General Content
Great graphics joined with simple lessons which develop the subject of geothermal energy. Seems somewhat elementary for 7th through 9th grade students.

Presentation
Great diagrams. elementary video—probably the cartoon part would be insulting to older kids, but the diagrams and information are good.

Pedagogy
Students are encouraged to work together in groups. No formal assessment.

Teacher Usability
Highly organized with a specific teacher instruction section. Useful for individuals with a limited science background. States specific framework correlations within curriculum.

Energy Content
Great job on thoroughly exploring geothermal energy and it’s uses.

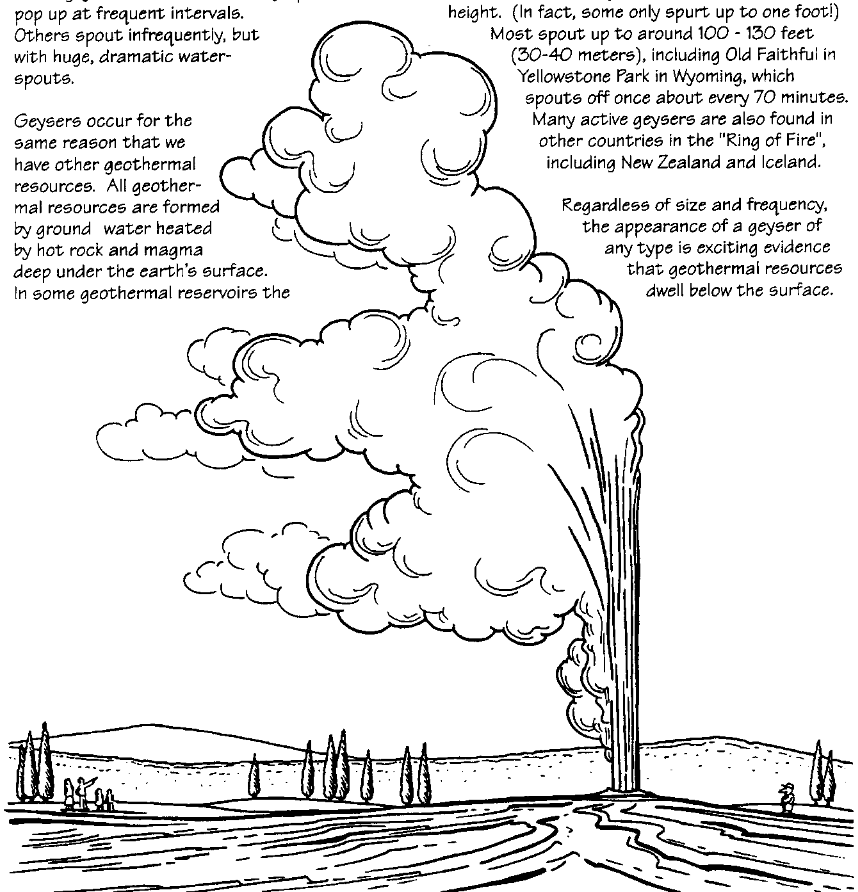
WHAT IS A GEYSER?

Scalding hot water and steam suddenly gush out of the earth. What is this strange apparition? It's a natural geothermal hot water fountain called a geyser. The name comes from the Icelandic word, "Geysir," meaning "gusher". Some geysers send up their spouts regularly, every few minutes, hours or days. Others are very irregular. Some geysers have small, bubbly spouts which pop up at frequent intervals. Others spout infrequently, but with huge, dramatic waterspouts.

Geysers occur for the same reason that we have other geothermal resources. All geothermal resources are formed by ground water heated by hot rock and magma deep under the earth's surface. In some geothermal reservoirs the pressure builds until it has to be released. So hot water and steam whoosh up through weak areas in the rock to the surface, making a hot water and steam fountain.

Some geysers have been known to shoot as high as 1,500 feet (460 meters), such as one found in New Zealand. Most geysers never reach this height. (In fact, some only spurt up to one foot!) Most spout up to around 100 - 130 feet (30-40 meters), including Old Faithful in Yellowstone Park in Wyoming, which spouts off once about every 70 minutes. Many active geysers are also found in other countries in the "Ring of Fire", including New Zealand and Iceland.

Regardless of size and frequency, the appearance of a geyser of any type is exciting evidence that geothermal resources dwell below the surface.

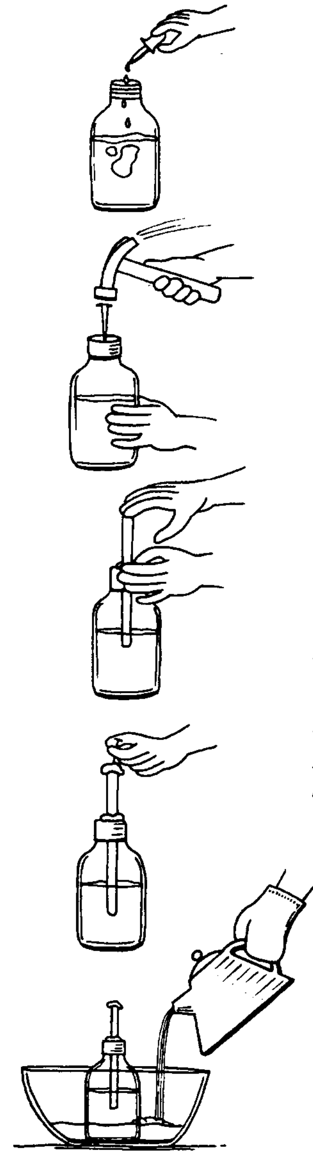


MAKE YOUR OWN GEYSER

In this experiment you will create your own "geyser" using some of the same forces that cause "real" geysers.

Geysers are the result of hot water and steam building up great pressure under the earth's surface. When the heat and pressure are great enough, the water expands (producing steam) and pushes the hot water in a gush up through weak spots and cracks in the earth's surface.

Materials
(Per group of students):
- bowl
- small strong bottle with a screw cap (preferably glass)
- modeling clay
- straw
- pin
- some food coloring or ink
- large nail & hammer
- a method to heat water
- hot mitts
- goggles, if possible
- water



Directions:

1.) Make a hole in the bottle's cap using the nail and hammer. Heat up water so that it will be boiling when you need it.

2.) Half fill the small bottle with cool water. Add a few drops of the ink or food coloring.

3.) Screw on the cap tightly and push the straw through the hole in the cap. Seal the hole well with clay.

4.) Stuff a small piece of clay in the top of the straw. Make a tiny hole all the way through the clay with the pin. Remove the pin.

5.) Pour hot water into the bowl. Stand the bottle in the bowl. Observe what happens. As the air inside the small bottle warms up, it will push the colored water up and out of the straw. This is because the air and water expand when they are heated and spread out, just as the steam expands underground.

GRADES 7-9

Energizing Your Future with Energy, Economics and the Environment

National 4-H Council
National 4-H Supply Service
c/o Cresstar Bank
P.O. Box 79126
Baltimore, MD 21279-0126
301-961-2934
301-961-2937 (fax)

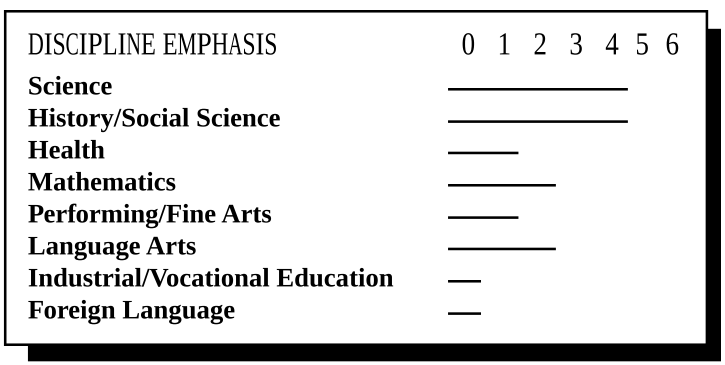
Item #ES1009, $5 per copy; 1996.

Grades K-12. Based on review of materials for grades 7-9.

This guide contains five chapters, each focusing on a different topic related to the interrelationships between energy, economics, and the environment.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B-**
Pedagogy	**B-**
Teacher Usability	**B-**
Energy Content	**B**



COMMENTS

General Content
Helps students see the economics of energy use—supply and demand. Some project ideas.

Presentation
Has some interesting approaches and perspectives. No student materials, just teacher materials.

Pedagogy
Requires higher level thinking skills and application of concepts. No assessment activities.

Teacher Usability
Some extensions seemed more appropriate than the discussion lessons. Includes a developmental characteristics section and a chapter activity matrix.

Activity 3.2
Auctioning Energy

Activity Goals
To demonstrate how natural resources such as energy are subject to the laws of supply and demand.

Preview
Participants play a game illustrating how supply and demand affect energy prices.

Ages: 9 to 18
Style: adult or teen led
Life Skills: disagreeing and refusing, expressing an opinion, observing and listening, asking questions to get information, comparing and selecting alternatives, managing resources to achieve a goal
Pre-Activities: 1.1, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1
Time Needed: 30 minutes
Group Size: any
Indoors or Outdoors: either
Materials Needed: copies of Activity Sheet 3.2A cut apart; different types of wrapped candies

How to Do the Activity
Explain that prices help people decide what to buy, what to make, and what to sell. But how do you think prices are set? (Ask participants to give ideas.)

Prices are influenced by the *law of supply and demand*. As the price of bicycles goes down, more people want to buy them. But as the prices go down, fewer people want to sell them. So the prices may rise because the supply is influenced. As the price of bicycles go up, more people want to make and sell them, but fewer people want to buy them. In the American marketplace, the demand and supply match up fairly closely.

To demonstrate supply and demand, play the following game with the group. Give one participant a handful of candies representing a supply of an energy source (coal, oil, wood, etc.). This person will be the "Energy Auctioneer." In this situation, there is a limited supply of energy (one handful) for the entire group.

Give each person in the rest of the group 10 "dollars" from Activity Sheet 3.2A. Have the Energy Auctioneer ask people to place bids for the handful of candies. Start the bidding with one dollar. Caution participants that they will be bidding on several rounds of candies, so they probably don't want to spend all their money right away. Each round of candies may be different.

Talk about what is happening as the auction continues. Notice that as the price increases, fewer and fewer people bid (i.e., price increases, demand decreases). At some point the price gets so high that most people don't feel it's worth buying the product. Give the handful of candies to the highest bidder.

As a real-life example, note that in the 1970s the supply of oil in the United States (and other countries) was restricted by oil-producing nations. This caused prices to rise. Eventually prices got so high that people began to find ways to use less oil (lower the demand). They purchased more gas-efficient cars and conserved energy in their homes.

In the next round of the game, something new happens. Other people want to make money too, so

they decide to start selling candies. Give four people each a handful of candies different from each other. Now each of these four is an Energy Auctioneer. The supply of energy resources is much larger now.

Start the bidding process again at one dollar. Have all four Energy Auctioneers try to "sell" their energy resources at the same time. What happens? As the supply increases (assuming demand is the same), prices fall.

Ask the group: Suppose only one Energy Auctioneer can sell energy resources. What would happen? (The price would rise. This is called a monopoly. The U.S. government regulates industries to discourage monopolies.) What if another energy source (for example, solar) became available? (It depends on the price of the solar energy--if it is less than the prices of existing sources of energy, people would buy it.) What would happen to the demand for the first energy source? (It would generally go down. However, it might stay stable or even increase, if more industries and businesses were started as a result of lower energy prices.)

Share the following illustration with participants by redrawing it on a chalkboard or flip chart. This will help summarize the basics of energy economics.

Illustration CC

Evaluating Progress
Explain how the laws of supply and demand would affect the price of a favorite product (football, CD, perfume). What would happen to the price if demand increased? (Generally, it would go up.) Decreased? (Generally, it would go down.) What would happen to the price if supply increased? (Generally, it would go down.) Decreased? (Generally, it would go up.)

Fair Game
Research and report on a time in history and how energy sources were affected by supply and demand (e.g., the energy crisis of the 1970s). Show how supply and demand affected energy prices and the effect that had on people's lives.

All for One and One for All
Help residents in your community who have difficulty paying for energy by offering to weather strip their homes or provide other energy saving work. Your local utilities might have similar programs already in place that you can volunteer for. Be sure to evaluate as best you can whether your action saves energy. Ask yourself: if we replace the light bulbs in a den with low wattage ones, will people just use more lamps to do the same jobs? If we help people block drafts at the bottoms of their doors, are we using materials that provide a good return, since it took energy to make the products in the first place? Think about it, and help educate people about using energy and other resources wisely.

Learning to be Water Wise and Energy Efficient

Learning to be Water Wise and Energy Efficient
Program Fulfillment Center
2351 Tenaya Drive
Modesto, CA 95354
888-438-9473
209-529-0266 (fax)
http://www.getwise.org

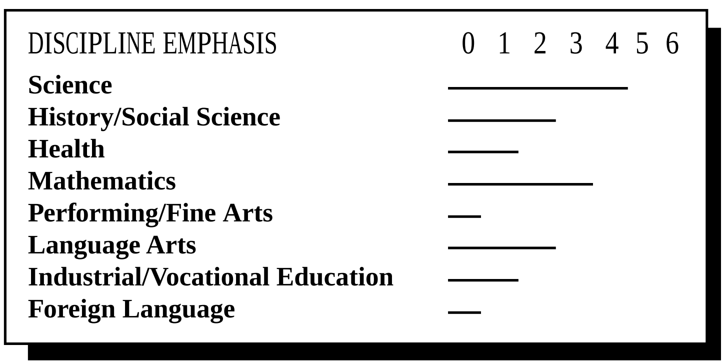
$25-40 per student (includes four components which may be purchased separately: water, light, comfort, CD rom game); 1995.

Grades 4-8

This program involves students in activities that, when concluded, will result in their learning ways to consume less water and energy.

REPORT CARD

Overall Grade	**B**
General Content	**B**
Presentation	**B**
Pedagogy	**B-**
Teacher Usability	**B**
Energy Content	**B-**



COMMENTS

General Content
Involves parents and kids with school and community goals. Many great energy saving ideas which are easy to do.

Presentation
Provides samples of water conservation equipment. Good posters on the water cycle and electrical generation.

Pedagogy
There are no objectives provided. Discussion questions do not encourage use of higher order thinking skills.

Teacher Usability
Background information for the teacher is limited.

HIGH EFFICIENCY SHOWERS ARE A BLAST!

Activity Three

The last time you took a shower, you used about 28 gallons of water. Twenty-eight gallons of water went down the drain, just so you could wash your body, and maybe your hair.

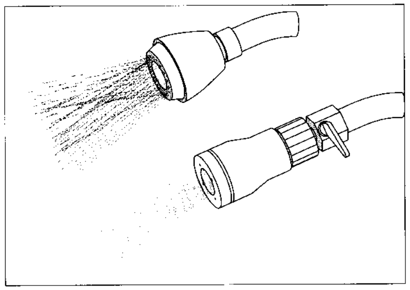
So what? We have lots of water, right? Wrong! Water is a limited resource. That means we don't always have enough of it to go around. Since people cannot live without water, we need to learn how to keep from wasting it.

Find the Correct Answer:

What is the simplest way to reduce the amount of water your family uses in the shower each year?

a. Take fewer showers.
b. Take shorter showers.
c. Replace your standard showerhead with a high efficiency showerhead.

If you answered "a" or "b," you are close but not correct. The question asked for the "simplest" way to reduce shower water. You save water by cutting back on your time in the shower. But you have to change the way you do things. When you use a high efficiency showerhead—answer "c"—you spend the same amount of time in the shower. And you still save water.

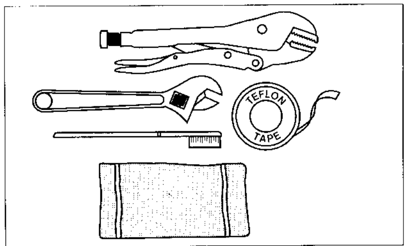


Compare the water flow of the regular showerhead (top) and the high efficiency showerhead (bottom).

High efficiency showerheads all have one thing in common: they use less water. A family of four, for example, can save nearly 34,500 gallons of water and almost $280 each year just by switching showerheads.

How to Make the Switch

1. **Talk to your parents first.** Show them the new high efficiency showerhead. Tell them they will save water, energy and money by using one. Promise them that the new shower will feel just as good as the old.
2. To install the new showerhead, follow the instructions provided. **Your parents will need:**



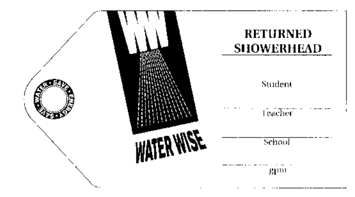
- Vise grip pliers
- Crescent wrench
- Old toothbrush
- Teflon tape
- Cloth

3. It might be helpful if you read the directions to them.
4. Grip the shower arm about one inch above the showerhead attachment nut with vise grip pliers.
5. Hold the vise grip pliers in place. Using a crescent wrench, turn the showerhead attachment nut slowly in a counterclockwise direction. Remove the old showerhead.
6. Flush out the shower pipe by turning on the water and running it for five seconds.
7. Clean threaded area of shower arm with an old toothbrush.
8. Wrap teflon tape three times clockwise around threaded tip of shower arm.
9. Screw the high efficiency showerhead onto the taped part of the shower arm. Place cloth inside the crescent wrench grip area and tighten slightly. Now, you can enjoy your shower while consuming less water and the energy it takes to heat the water!

Note:

Please Return the Old Showerhead

Your sponsoring utility wants to know that you and your family installed your new high efficiency showerhead. Therefore, you are asked to use the identification sticker included in your kit. Fill out the information requested on the sticker, affix it to the old showerhead, and return it to school. Place it in the container provided for this purpose in your classroom.



Identification sticker. Attach to your old showerhead.

BONUS ACTIVITY

If your sponsor is not collecting the old showerheads, how might your class use them to demonstrate to the community what you have been doing to conserve water and energy? Let students brainstorm possibilities.

BONUS ACTIVITY

Can you solve this puzzler after reading all the facts below?
(Hint: Some of the facts simply provide information; others give clues to help you solve the problem.)

Puzzler:
Rufus Richmond takes one shower a day. His very messy son, Ralph, takes a bath every night before he goes to bed. Rufus' wife, Rita, prefers to shower every other day. About how much water do the Richmonds use to keep themselves clean each year?

Facts:
- **Most Americans take one shower each day.**
- **The average person showers for 7.5 minutes.**
- **The average shower releases about four to six gallons of water each minute.**
- **About 66 percent of the water needed for a warm shower must be heated.**
- **People who take baths use 30-40 (35 average) gallons of water with each bath.**

Answer:
Rufus takes one shower a day for 7.5 minutes each time. Since Rufus is not using a high efficiency shower head, he uses 4 gallons of water each minute; 7.5 x 4 = 30 gallons per day [30 x 365 = 10,950]. Rufus uses 10,950 gallons of water per year. Ralph uses 35 gallons of water per day [35 x 365 = 12,775]. Ralph uses 12,775 gallons of water each year. Rita takes exactly half the amount of showers that Rufus takes [10,950 divided by 2 = 5,475]. Rita uses 5,475 gallons of water each year. Add 10,950 to 12,775 and 5,475 and you get the solution. The Richmond family uses 29,200 gallons of water each year to keep clean.

Environmental Science Activities Kit

Prentice Hall
Order Processing Department
P.O. Box 11071
Des Moines, Iowa 50336
515-284-6751
515-284-2607 (fax)
http://www.phdirect.com/phdirect

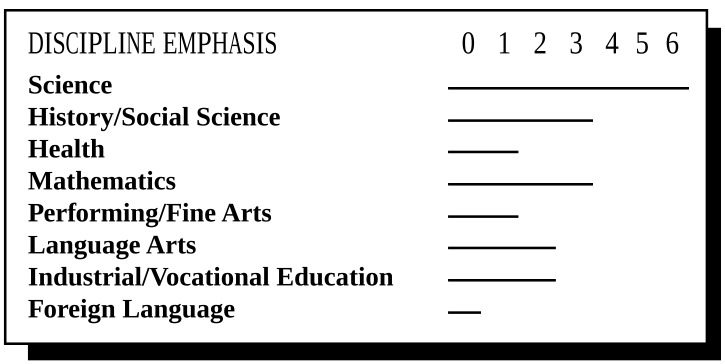
$29.95 each; 332 pages, 1993.

Grades 7-12. Evaluation based on review of materials for grades 10-12.

Thirty-two interdisciplinary science lessons organized into six topical units focusing on major environmental issues.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**A-**
Pedagogy	**B+**
Teacher Usability	**A**
Energy Content	**A-**



COMMENTS

General Content
Good for physical science/environmental science students. May not be truly challenging for advanced high school students.

Presentation
Student materials for reproduction are nicely designed and easy to use.

Pedagogy
A wealth of student activities with many alternative strategies and learning extension opportunities.

Teacher Usability
Materials are easy to obtain at no or low cost. Easy to integrate into individual student projects. Great reference for activities that emphasize ideas.

Name ______________________________ Class ____________ Date ____________

22.2 Fossil Fuel Extraction: Instructions and Data

Your teacher will provide you with a cookie. This cookie represents a land area that may contain deposits of coal (represented by raisins), oil (represented by pieces of nuts), and/or natural gas (represented by chocolate pieces). You will also be provided with a toothpick, which represents the mining and drilling equipment used in obtaining the coal, oil, and natural gas.

Your job is to try to remove as much of the coal, oil, and natural gas as possible with as little damage to the environment as possible.

Imagine that the top surface of the original cookie is an area of land on which various kinds of plants and animals live.

In the space below, sketch the cookie surface before and after "mining."

Also, record the amounts of the various resources that you were able to obtain and the amount of "waste" generated. (**Estimate:** about _______% of the original cookie.)

BEFORE MINING | **AFTER MINING**

resources recovered (as % of the original cookie):

_____% coal (raisins) _____ % natural gas (chocolate)

_____ % oil (nut pieces) _____ % waste (crumbs and pieces)

Name ______________________________ Class ____________ Date ____________

22.3 Fossil Fuel Extraction: Questions

1. What are some problems associated with obtaining and using coal?
2. What can be done to reduce or avoid these problems?
3. What are some problems associated with obtaining and using oil?
4. What can be done to reduce or avoid these problems?
5. How can saving electricity help reduce the need for mining and shipping coal?
6. List some ways that you could reduce your electricity use.
7. How can reducing gasoline consumption reduce the need for mining, shipping, and refining oil?
8. List some ways that you could reduce the need for oil?
9. What are some advantages and disadvantages of natural gas as an energy source?